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EVALUATION OF SELECTED BAT HABITAT SITES ALONG THE MAMMOTH-NORRIS GRAND LOOP ROAD CORRIDOR, YELLOWSTONE NATIONAL PARK, WYOMING, 1997-1998

Prepared for the
Montana Natural Heritage Program,
The Nature Conservancy,

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INTRODUCTION

Numerous sites along the Norris Junction-Mammoth Junction road were evaluated for bat use during the summer season in 1997 and 1998. All known cave sites were checked and special attention was given to water bodies near the road since these areas are known to draw bats from the surrounding region for feeding and interaction. A total of 33 sites were studied ranging from a known maternity pit cave site to a cold alpine pond. The primary objective was to identify and document bat presence and activity along the corridor affected by reconstruction of the Grand Loop Road between Norris and Mammoth. Information gathered from field activities would be used to make sound management decisions on protecting the available resources and reducing the impact of construction activities on future projects of this type.

Figures 1 through 6 identify the locations of each site studied on a portion of the USGS topographic quadrangle and Table 2 is a listing of the latitude and longitude readings from either the topo map or from GPS instrument readings taken in the field. Although care was taken to get as much information as possible, a wide variety of habitat settings were tested to provide the clearest picture of overall bat activity in the study area.

METHODS

Bat occurrence and identity were determined in open areas and in probable roost sites located within the road corridor using traditional and low impact methods. Mist netting and subsequent in-hand identification of captured bats was attempted at one or two sites each night, although weather conditions on some nights prevented deployment of the nets. Known caves and other likely roost sites were visited and examined for evidence of bat use and suitability. For three of the caves in the Mammoth area, vertical rope techniques were employed to safely enter the pit entrances of natural caves. For confined spaces in areas where poison gas might be encountered, a gas monitor was used to detect oxygen deficiency and the presence of methane or explosive gases.

For a greater number of sites an ANABAT ultrasonic bat detector (Titley Electronics; Ballina, Australia) was used in conjunction with a Titley Delay Switch and cassette recorder to monitor and record bat activity during the nighttime hours. These electronic sensors can successfully record ultrasonic calls over a wide band of frequencies from 20 to 180 kHz without producing any sound of their own and are undetectable by bats. Many bat species can be identified from their recorded calls on the basis of known characteristics and call structures revealed from analysis of the audio recordings. Analysis of the recordings took place at the Montana Natural Heritage office in Helena using an IBM compatible personal computer with ANABAT II zero crossings analysis interface module and software.

RESULTS

Bats of six different species were identified from calls recorded by the Titley Electronics' ANABAT set-up. Table 3 lists those species and their common names. Numerous undifferentiated *Myotis* were detected but could not be identified to species with certainty because of poor call quality or insufficient duration. Because of the similarity of all *Myotis spp.* calls, they often cannot be distinguished from each other by analysis of the calls alone. Two of the identified bat species are of special concern, Townsend's big-eared bat, *Corynorhinus townsendii*, and the fringed myotis, *Myotis thysanodes*.

Table 1 lists the results of from each site and provides a summary of numbers of calls during each hour time period from dusk until dawn.

Devil's Kitchen: This is a known maternity site for bats in the Mammoth area. Historically, it is well known for Townsend's big-eared bats, but it also provides roosting for other species in an area where a variety of bat species have been captured and recorded.

On September 27, 1997, a descent was made into the cave to document bat activity and environmental conditions. A partial survey was made to record the dimensions and identify roosting areas important to bats observed at that time. Approximately 86 feet of passage were surveyed with about 40 more feet left to be

included.

Five *Corynorhinus townsendii* were observed on the ceiling of the cave, 25 or 30 feet above the floor of the passage. One was at the NW end of the entrance room and the other four were near the eastern extreme of the cave, in a dome area about 28 feet high. Our proximity did not disturb them and although they were aware of our presence they did not become agitated.

Ambient temperatures in the cave were quite warm. At the bottom of the entrance drop $T_{\text{Dry Bulb}}$ equalled 77°F and $T_{\text{Wet Bulb}}$ was 65°F. Toward the east end of the cave, near the floor, the temperature was much warmer and the air seemed stuffy. More of the bats were in this area of the cave and some packrat litter was scattered across the passage floor. Measurements at this end of the cave found $T_{\text{Dry Bulb}}$ was 83°F and $T_{\text{Wet Bulb}}$ was 72°F. Air monitoring for oxygen depletion found no bad air anywhere in the cave.

Two hot spring pools are located in the floor of the cave about 9 feet apart. Their temperatures were warm and both had thick crusts of calcite raft deposits floating on the water surface. The eastern pool measured 7½ feet long and up to 3 feet wide, at 94.2°F. The western pool was at about the same water level, measuring about 3½ feet long by 1¼ feet wide, at 85°F. No bubbling was observed in either pool.

ANABAT recordings outside the entrance identified four bat species in the vicinity. These included *Corynorhinus townsendii*, *Eptesicus fuscus*, *Lasionycteris noctivagans*, and some undifferentiated *Myotis spp.*

Pinion Terrace site: Jeweled Cave and the other large cave here were monitored for bat activity without success. Interior examination of these and the other small caves on Pinion Terrace found a few traces of bat guano but no large colonies. One *Myotis spp.* bat was observed in the crack-like cave near the edge of the terrace. Due to the vertical nature of this cave, a close examination of the bat could not be made.

All the caves on this terrace have normal interior temperatures. Thermal activity at this level on Terrace Mountain has been dormant for hundreds of years. Air quality is also excellent.

Mammoth Hot Spring Reservoir, Joffe and Africa Lakes: The area around these small lakes had more bat activity than any other. These small ponds offer an excellent foraging area and also provide open water free of hot spring discharges. These ponds present the closest large, open stretches of water to the rocky cliffs in Glen Creek canyon and the caves and shelters of the upper Mammoth Hot Springs terraces. Five or more species of bat were detected here, including *Corynorhinus townsendii*, *Eptesicus fuscus*, *Lasiurus cinereus*, *Lasionycteris noctivagans*, and one possible *Myotis thysanodes*. Two of these species, *C. townsendii* and *M. thysanodes*, are species needing special management consideration because of intolerance to disturbance and declining population. *Myotis thysanodes* may also have been recorded at other sites, however, most species of *Myotis* are difficult to distinguish from their calls. Many of the sites sampled had calls identified as *Myotis spp.* because a definitive identification could not be made.

Indian Creek Campground Bridge: Thirty-eight *Myotis* calls were recorded here on 12 Aug, 1997, along with seven other unidentified calls. Sample sites both up and down stream of the bridge (sites 12 and 14) recorded no calls.

Willow Flats at Moose Exhibit: A large number of bats were observed feeding over the river here. *Eptesicus fuscus* were identified, but most were undifferentiated *Myotis spp.* making multiple passes through the meadow.

The rest of the sites produced few or no recorded calls, as can be seen from Table 1. In many cases, site characteristics were similar or the same as those found at the very active sites. Weather conditions on some nights may have suppressed activity. On September 5 in particular, moderate rain and high winds lasting all night filled the recording tape with storm noise and probably prevented bats from leaving their roosts. Additional monitoring would prove valuable in obtaining an accurate assessment of bat use through the summer season.

DISCUSSION

Visual inspection of known caves and analysis of ANABAT recordings revealed that bats were not evenly distributed along the road corridor and that they were more likely to be found close to historic structures and in areas known to contain established roost sites. Only one cave site, Devil's Kitchen, contained more than one or two bats. Five were observed and a few more were suspected. The most productive recording sites were found at lower elevations, near Mammoth, and may have reflected the greater abundance of preferred roost sites in those areas.

Summarizing the detection results from all sites, bats were detected at 19 (55.9%) locations, with data unavailable for one additional site. Fourteen sites (41.2%) had no bat detections. ANABAT instruments detected few bats around water bodies near active hot springs or in the Norris area. Reasons for the lack of bat activity are not known. Moths and other flying insects were observed at all the sample sites. This aspect of bat distribution needs more study to understand why bats are selectively avoiding certain areas. It is unlikely that all species avoid thermal areas, since there is a well known colony site in a very active thermal area south of Norris Junction.

The Hoodoo area in particular was disappointing for its lack of recorded activity. This location should have produced numerous bat calls because of the large number of small caves and roosting spots available. Weather conditions spoiled the opportunity to record bat activity and there was insufficient time available to repeat the sampling. Other sites were skipped or dropped because of time or equipment limitations in favor of covering the most territory within the area of interest.

Previous bat studies in the Park have involved visual observation of flying individuals or hand counts of known colonies. These methods impose severe limitations and require an unreasonable commitment of time and manpower. Employing the ANABAT instrument with recording capability greatly increases the efficiency and productivity of the scientific effort and produces reliable data over a large geographic area with a modest investment of time and physical effort.

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TABLE 1
ANABAT SURVEY RESULTS
YELLOWSTONE NATIONAL PARK - GRAND LOOP ROAD CORRIDOR

#	Site	Date	Species ⁽¹⁾	Hourly Group Starting Time/Individuals												Site Totals
				2	2	2	2	0	0	0	0	0	0	0		
				0	1	2	3	0	1	2	3	4	5			
				0	0	0	0	0	0	0	0	0	0			
1	"Africa Lake" - Mammoth Junction	13Aug97	EPFU		1									1		
			LACI		1								1			
			MYSP	35	113								148			
			UNKN	3	20								23			
				38	135								173			
2	Devils's Kitchen (Portal)	12Aug97	COTO		1	5								6		
			EPFU	4	5	2							11			
			LANO	6	33	1							40			
			MYSP	1	5	5							11			
			UNKN		10	4							14			
						11	54	17						82		
		5Sept98	None													
		6Sept98	COTO	1									1			
			MYSP	2		1	1	1					5			
			UNKN		1			1					2			
				3	1	1	1	2				8				
3	Pinion Terrace site	13Aug97	None													
4	Grand Loop Road near trail head to upper terraces	20Aug98	EPFU	1	9			1		1			3	15		
			MYSP		5	4	5	2		2	6		24			
			UNKN			2			1		1		1	5		
				1	14	6	5	3	1	1	3	6	4	44		
5	"Africa Lake", below Grand Loop Road and above Mammoth Hot Springs water supply reservoir	20Aug98	EPFU	11	5									16		
			LACI	1									1			
			LANO	1									1			
			MYSP		14	1		1	1	1	2		2	22		
			UNKN		3									3		
				13	22	1		1	1	1	2		2	43		
6	Mammoth Hot Spring water supply reservoir	6Sept98	EPFU		1									1		
			LANO	1	2								3			
			MYSP	10	48	2		1					61			

TABLE 1
ANABAT SURVEY RESULTS
YELLOWSTONE NATIONAL PARK - GRAND LOOP ROAD CORRIDOR

#	Site	Date	Species ⁽¹⁾	Hourly Group Starting Time/Individuals											Site Totals
				2 0 0 0	2 1 0 0	2 2 0 0	2 3 0 0	0 0 0 0	0 1 0 0	0 2 0 0	0 3 0 0	0 4 0 0	0 5 0 0		
			UNKN	4	7										11
				15	58	2		1							76
7	Joffe Lake	6Sept98	COTO	1 ⁽²⁾											1
			EPFU	2	3	10	9	6				1		31	
			LANO	4	1									5	
			MYSP	5	9	2	3	3				1	3	26	
			MYTH									1 ⁽²⁾		1	
			UNKN	2	6	7	2	2				1		20	
				14	19	19	14	11				4	3	84	
8	Lower Hoodoos	5Sept98	None												
9	Upper Hoodoos	5Sept98	None												
10	Glen Creek Bridge (Culvert)	13Aug97	MYSP												1
			UNKN											3	
														4	
11	Pond located east of Swan Lake Flats	20Aug98	None												
12	Sheepeater Cliffs at Gardner River	20Aug98	None												
13	Indian Creek Campground Bridge	12Aug97	MYSP		11	21		4	2						38
			UNKN		2	2	1	2						7	
						13	23	1	6	2					45
		20Aug98	EPFU				1								1
							1							1	
14	upstream of Indian Creek Campground Bridge	12Aug97	None												
15	Willow Flats at Moose Exhibit	22Aug98	EPFU		3										3
			MYSP	5	27	3							35		
			UNKN	2	7								9		
				7	37	3								47	

TABLE 1
ANABAT SURVEY RESULTS
YELLOWSTONE NATIONAL PARK - GRAND LOOP ROAD CORRIDOR

#	Site	Date	Species ⁽¹⁾	Hourly Group Starting Time/Individuals										Site Totals
				2 0 0 0	2 1 0 0	2 2 0 0	2 3 0 0	0 0 0 0	0 1 0 0	0 2 0 0	0 3 0 0	0 4 0 0	0 5 0 0	
16	Lilypad Pond, north end	4Sept98	None											
17	Beaver Lake, north end	22Aug98	None											
18	Solfatara Trailhead	22Aug98	MYSP	2										2
				2										2
19	Grizzly Lake Trail transect (data not available)	?	?											
20	Grizzly Lake Trailhead	4Sept98	None											
21	Roaring Mountain - across Grand Loop Road	22Aug98	EPFU		1									1
					1									1
22	North Twin Lake	4Sept98	LANO			1								1
			UNKN				1						1	
						1		1						2
23	South Twin Lake	22Aug98	LANO		5									5
			MYEV			2	1	1	1					5
			MYSP	3	28	42	6	5	5	3	3	1		96
			UNKN		1	5				1				7
				3	34	49	7	6	6	4	3	1		113
24	Nymph Lake	21Aug98	None											
25	unnamed pond west of Grand Loop Road, South of Nymph Lake, 2 miles North of Norris Junction	21Aug98	None											
		4Sept98	None?											
26	Large unnamed lake East of the Grand Loop Road, located north of Norris Campground - east end	21Aug98	None?											

TABLE 1
ANABAT SURVEY RESULTS
YELLOWSTONE NATIONAL PARK - GRAND LOOP ROAD CORRIDOR

#	Site	Date	Species ⁽¹⁾	Hourly Group Starting Time/Individuals											Site Totals
				2 0 0 0	2 1 0 0	2 2 0 0	2 3 0 0	0 0 0 0	0 1 0 0	0 2 0 0	0 3 0 0	0 4 0 0	0 5 0 0		
27	Large unnamed lake East of the Grand Loop Road, located north of Norris Campground - north side	4Sept98	MYSP	1										1	
				1										1	
28	Large unnamed lake East of the Grand Loop Road, located north of Norris Campground - near west end and west of marsh	4Sept98	None												
29	bank of Gibbon River below Norris Geyser Basin overlook pullout	4Sept98	UNKN			1								1	
						1								1	
30	Norris Campground, site B-43	4Sept98	UNKN					1						1	
								1						1	
31	Gibbon River Bridge, Grand Loop Road at Norris Campground	13Aug97	None?												
		21Aug98	UNKN	1	1									2	
				1	1									2	
32	Nuphar Lake - west end	21Aug98	UNKN	1										1	
				1										1	
33	area between bookstore and Norris Museum	6Sept98	None												
34	Gibbon Meadows Picnic Area, on bank of Gibbon River	6Sept98	MYSP		1									1	
					1									1	

⁽¹⁾ Codes for bat species are:

COTO [=] *Corynorhinus townsendii*
 EPFU [=] *Eptesicus fuscus*
 LACI [=] *Lasiurus cinereus*
 LANO [=] *Lasionycteris noctivagans*
 MYEV [=] *Myotis evotis*
 MYSP [=] *Myotis spp.*
 MYTH [=] *Myotis thysanodes*
 UNKN [=] unknown

⁽²⁾ Identification not certain.

TABLE 2
ANABAT SURVEY SITE LOCATIONS
YELLOWSTONE NATIONAL PARK - GRAND LOOP ROAD CORRIDOR

#	Site	Date	GPS Rover File	Latitude (N)	Longitude (W)
1	"Africa Lake" - Mammoth Junction	13Aug97			
2	Devils's Kitchen (Portal)	12Aug97			
		5Sept98	R090602A	44°57'56.2"	110°42'41.4"
		6Sept98	R090617A	44°57'56.1"	110°42'41.3"
3	Pinion Terrace site	13Aug97			
4	Grand Loop Road near trail head to upper terraces	20Aug98	R082101A	44°57'31.8"	110°42'45.3"
5	"Africa Lake", below Grand Loop Road and above Mammoth Hot Springs water supply reservoir	20Aug98	R082101B	44°57'1.7"	110°42'46.8"
6	Mammoth Hot Spring water supply reservoir	6Sept98	R090616A	44°56'55.5"	110°42'15.5"
7	Joffe Lake	6Sept98	R090615A	44°56'53.8"	110°42'3.3"
8	Lower Hoodoos	5Sept98	R090601A	44°56'37.2"	110°42'53.3"
9	Upper Hoodoos	5Sept98	R090600A	44°56'39.3"	110°43'8.3"
10	Glen Creek Bridge (Culvert)	13Aug97			
11	Pond located east of Swan Lake Flats	20Aug98			
12	Sheepeater Cliffs at Gardner River	20Aug98	R082102A	44°53'30.8"	110°43'45.8"
13	Indian Creek Campground Bridge	12Aug97			
		20Aug98	R082102B	44°52'56.5"	110°44'5.4"
14	upstream of Indian Creek Campground Bridge	12Aug97			
15	Willow Flats at Moose Exhibit	22Aug98	R082302B	?	?
16	Lilypad Pond, north end	4Sept98	R090515A	44°50'9.1"	110°43'48.8"
17	Beaver Lake, north end	22Aug98	R082302A	44°49'3.3"	110°43'44.2"
18	Solfatara Trailhead	22Aug98	R082301B	44°48'25.0"	110°44'3.8"
19	Grizzly Lake Trail transect	?			
20	Grizzly Lake Trailhead	4Sept98	R090514D	44°47'55.9"	110°44'44.4"
21	Roaring Mountain - across Grand Loop Road	22Aug98	R082301A	44°46'44.9"	110°44'31.6"
22	North Twin Lake	4Sept98	R090514B	44°46'32.9"	110°44'14.6"
23	South Twin Lake	22Aug98	R082300A	44°46'21.2"	110°44'4.9"
24	Nymph Lake	21Aug98	R082200A	44°45'10.2"	110°43'30.5"
25	unnamed pond west of Grand Loop Road, South of Nymph Lake, 2 miles North of Norris Junction	21Aug98	R082200B	44°44'59.7"	110°42'56.4"
		4Sept98	R090514A	44°44'59.7"	110°42'55.9"
26	Large unnamed lake East of the Grand Loop Road, located north of Norris Campground - east end	21Aug98	R082200C	44°45'3.8"	110°42'44.2"
27	Large unnamed lake East of the Grand Loop Road, located north of Norris Campground - north side	4Sept98	R090513A	44°44'38.7"	110°42'30.0"
28	Large unnamed lake East of the Grand Loop Road, located north of Norris Campground - near west end and west of marsh	4Sept98	R090513A (part 2)	44°44'36.5"	110°42'14.4"
29	bank of Gibbon River below Norris Geyser Basin overlook pullout	4Sept98	R090513C	44°44'17.3"	110°42'40.6"
30	Norris Campground, site B-43	4Sept98	R016014A?	?	?
31	Gibbon River Bridge, Grand Loop Road at Norris Campground	13Aug97			

TABLE 2
ANABAT SURVEY SITE LOCATIONS
YELLOWSTONE NATIONAL PARK - GRAND LOOP ROAD CORRIDOR

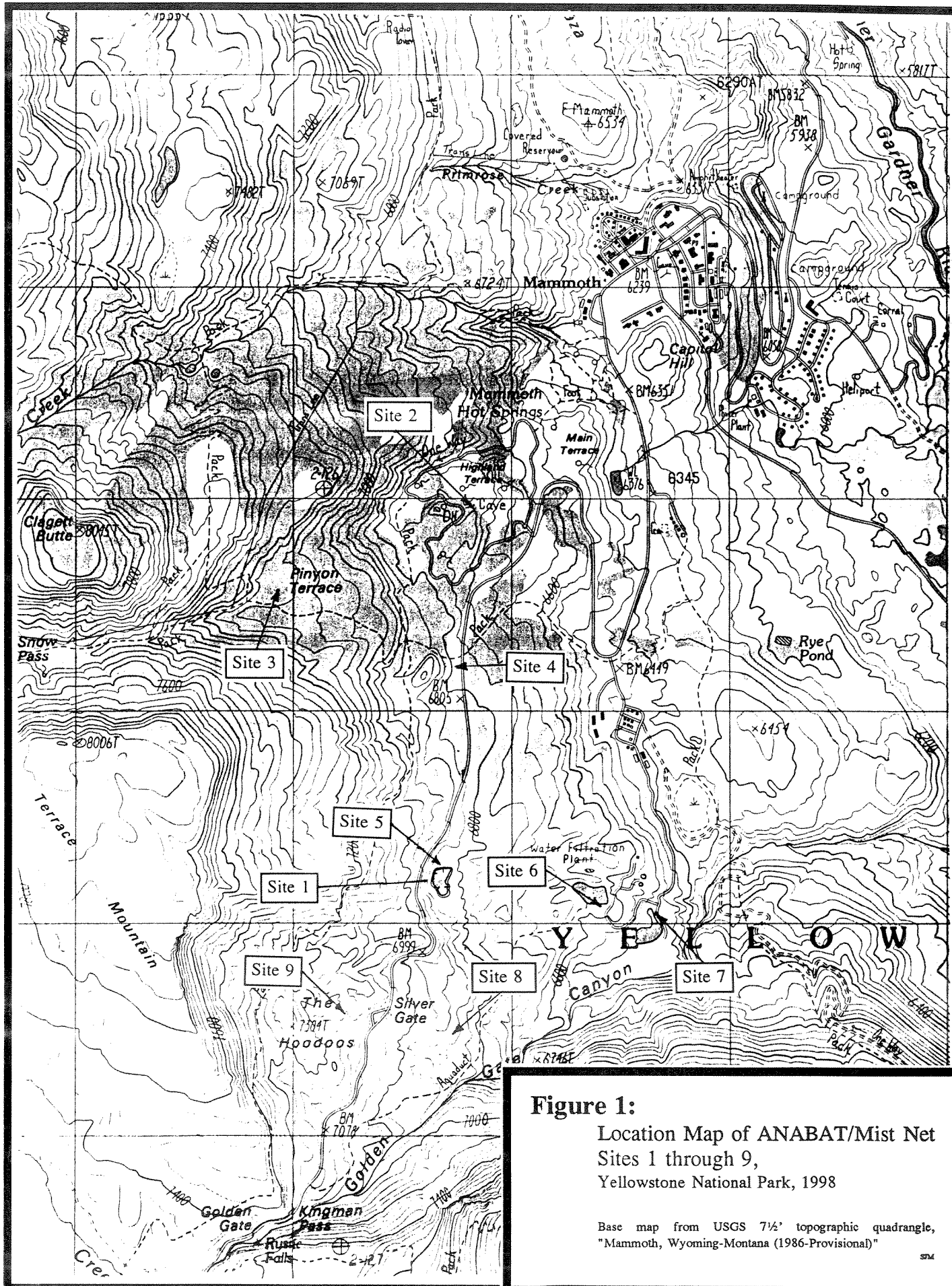
#	Site	Date	GPS Rover File	Latitude (N)	Longitude (W)
32	Nuphar Lake - west end	21Aug98	R082201A	44°44'18.1"	110°41'55.9"
33	area between bookstore and Norris Museum	6Sept98	R090703A	44°43'34.1"	110°42'12.4"
34	Gibbon Meadows Picnic Area, on bank of Gibbon River	6Sept98	R090702A	44°43'53.8"	110°41'30.3"

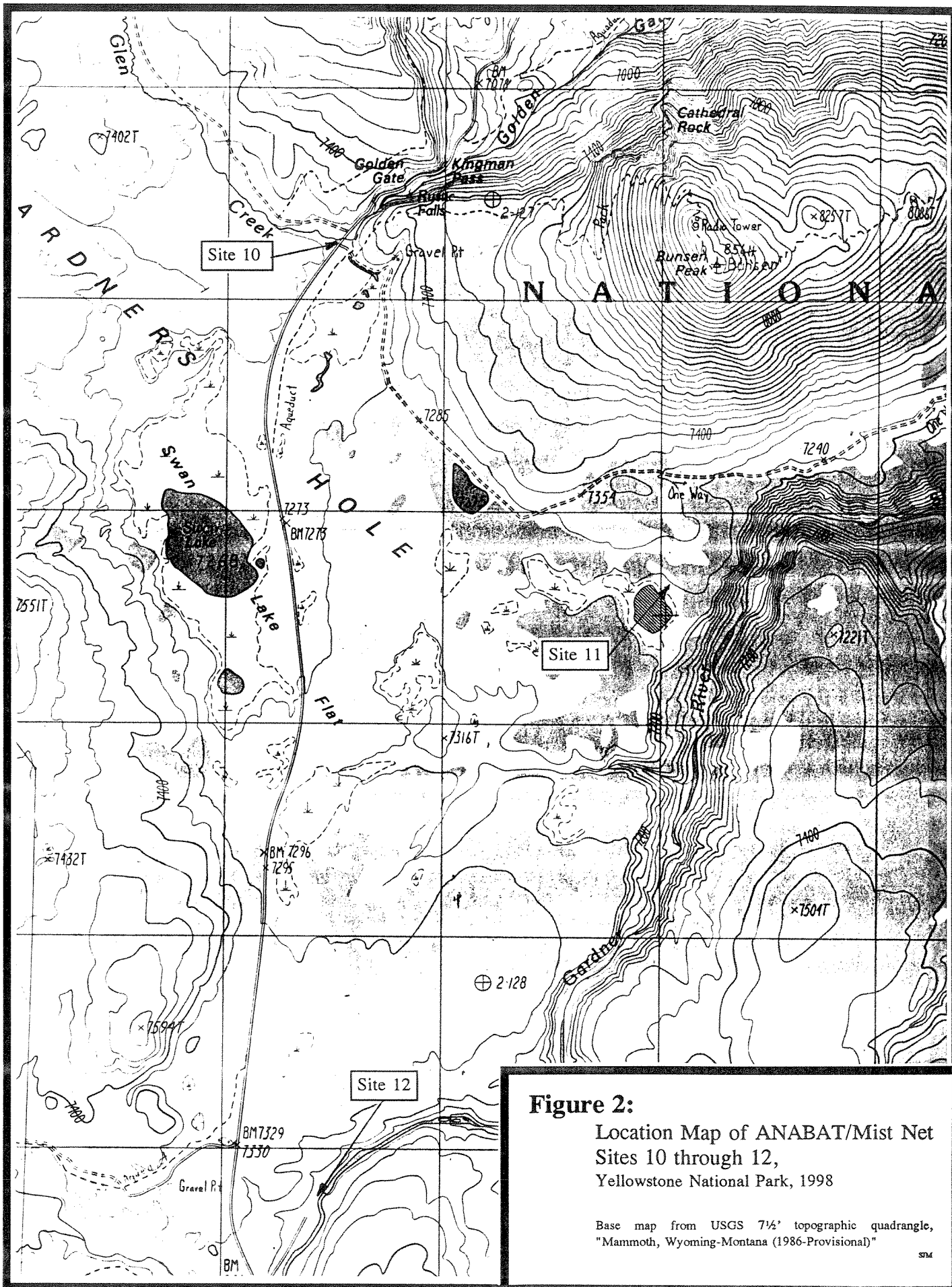
TABLE 3
LIST OF BATS DETECTED IN YELLOWSTONE NATIONAL
PARK⁽¹⁾

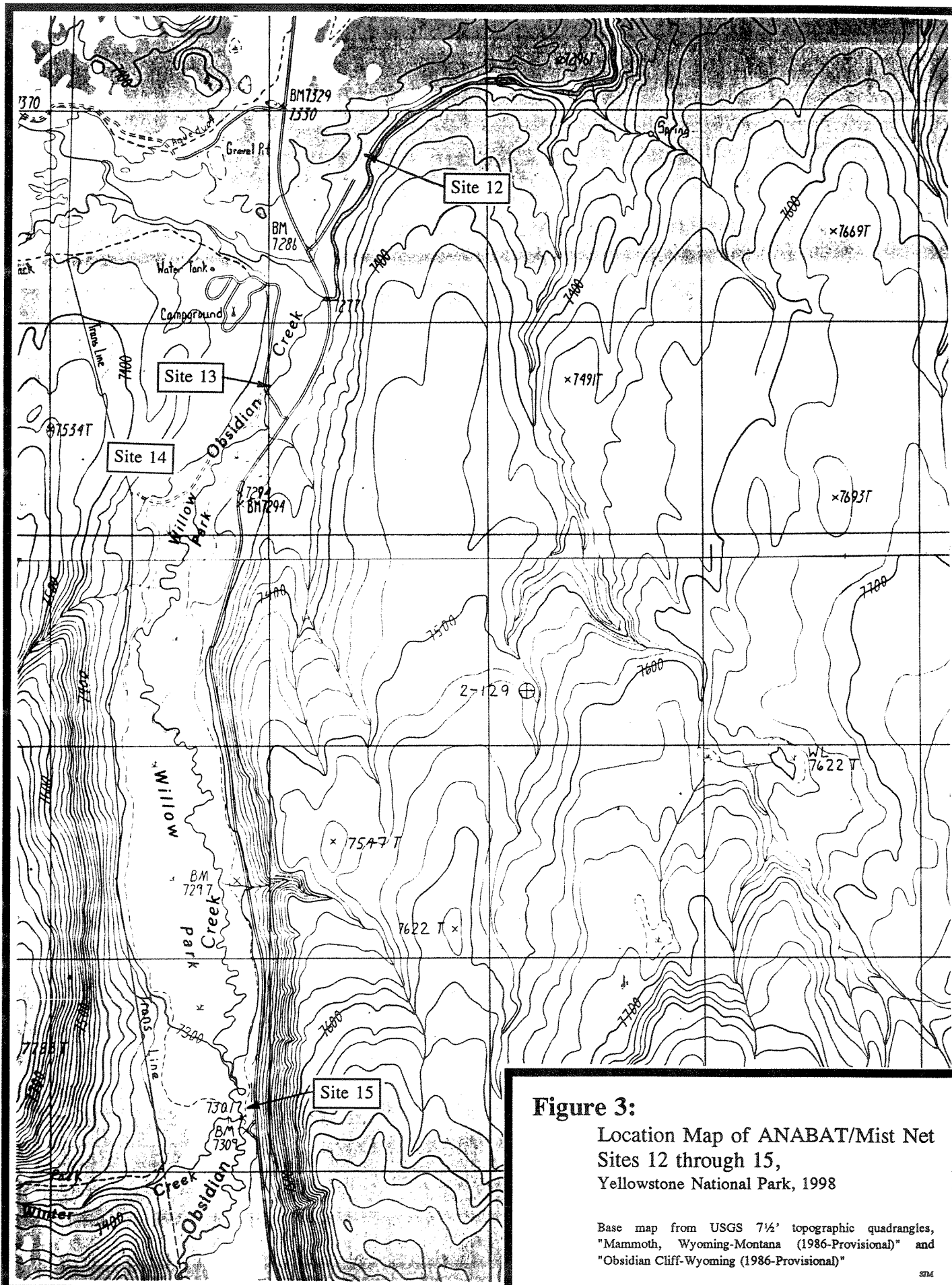
Scientific Name	Common Name	No. of Sites ⁽²⁾
<i>Corynorhinus townsendii</i>	Townsend's Big-Eared Bat	2 (5.9%)
<i>Eptesicus fuscus</i>	Big Brown Bat	9 (26.5%)
<i>Lasionycteris noctivagans</i>	Silver-Haired Bat	6 (17.6%)
<i>Lasiurus cinereus</i>	Hoary Bat	2 (5.9%)
<i>Myotis evotis</i>	Long-Eared Myotis	1 (2.9%)
<i>Myotis thysanodes</i>	Fringed Myotis	1 (2.9%)
<i>Myotis sp.</i>	unidentified Myotis	13 (38.2%)
Unknown	unidentified bat species	15 (44.1%)

⁽¹⁾ Data from Montana Natural Heritage Program field work, summer 1998.

⁽²⁾ The number and percentage of sites where this species was detected.







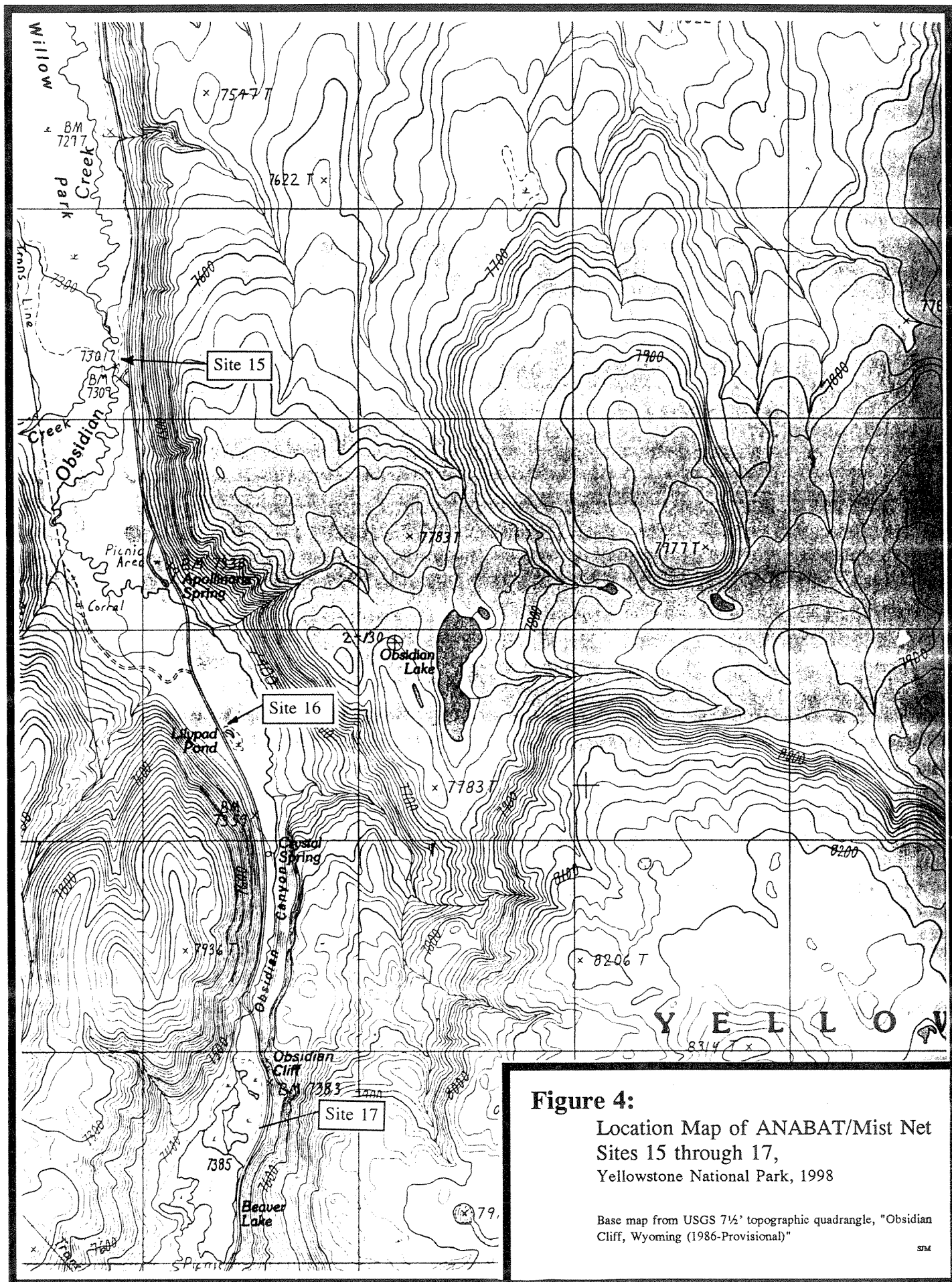


Figure 4:

Location Map of ANABAT/Mist Net
Sites 15 through 17,
Yellowstone National Park, 1998

Base map from USGS 7½' topographic quadrangle, "Obsidian
Cliff, Wyoming (1986-Provisional)"

